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Social determinants of disparities in weight among US children and adolescents

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Abstract

Purpose—To explore whether contextual variables attenuate disparities in weight among 18,639 US children and adolescents aged 2 to 18 years participating in the National Health and Nutrition Examination Survey, 2001 to 2010.

Methods—Disparities were assessed using the Symmetrized Rényi Index, a new measure that summarizes disparities in the severity of a disease, as well as the prevalence, across multiple population groups. Propensity score subclassification was used to ensure covariate balance between racial and ethnic subgroups and account for individual-level and contextual covariates.

Results—Before propensity score subclassification, significant disparities were evident in the prevalence of overweight and/or obesity and the degree of excess weight among overweight/obese children and adolescents. After propensity score subclassification, racial/ethnic disparities in the prevalence and severity of excess weight were completely attenuated within matched groups, indicating that racial and ethnic differences were explained by social determinants such as neighborhood socioeconomic and demographic factors.

Conclusions—The limited overlap in covariate distributions between various racial/ethnic subgroups warrants further attention in disparities research. The attenuation of disparities within matched groups suggests that social determinants such as neighborhood socioeconomic factors may engender disparities in weight among US children and adolescents.

Keywords

Epidemiologic methods; Health status disparities; Multilevel analysis; Propensity score; Obesity; Residence characteristics; Social determinants of health

Introduction

The monitoring and elimination of health disparities is a primary goal of the US Healthy People 2020 initiative; [1] low-income and some racial and ethnic minority groups are more

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likely to suffer from obesity and a variety of weight-related diseases [2–10]. Racial/ethnic and economic residential segregation leads to differential access to beneficial and adverse exposures for various subpopulations [11–14], as some racial and ethnic subpopulations are more likely to reside in neighborhoods characterized by social and structural disadvantage [11–13]. Inequities in the built and social environments have increasingly been the focus of research seeking to explain weight-related and other disparities [11–20].

There are also racial/ethnic disparities in the prevalence of extreme obesity among children [9,21–23]; these disparities are evident as young as preschool and observed within limited socioeconomic strata such as low-income samples [24,25]. Most prior studies have examined differences in the proportion of children falling above various body mass index (BMI) cutoffs (e.g., 97th or 99th percentile [9,22,23], 1.2 times the 95th percentile [21,26]). National estimates for the United States suggest that non-Hispanic black children are nearly twice as likely to fall above the 97th BMI percentile for age and sex compared with non-Hispanic white children (18.6% vs. 9.8%, respectively), and rates are also high among Hispanic children (15.6% [9]). Few studies have examined whether there are disparities in the severity of excess weight among over-weight or obese children on a continuous scale. Differences in the burden of excess weight within the overweight or obese category are important because of the increased risk of weight-related comorbidities associated with higher levels of excess weight [23,27–32]. Moreover, extreme obesity among children and adolescents is associated with elevated leptin levels, placing these children and adolescents at high risk of further weight gain and poor responsiveness to weight-loss interventions [27].

A handful of studies have examined social determinants of weight disparities. One limitation of these studies is the narrow overlap in the distribution of exposures between racial/ethnic subgroups, [33] leading to off-support inferences when traditional regression-based methods do not fully account for confounding [34–36]. Propensity score methods can be used to ensure samples are balanced on potential confounders such as neighborhood socioeconomic factors [36–38]. Few studies have used propensity score matching to examine racial/ethnic disparities [36]. Do et al. [39] reported that the gap in self-rated health between black and white adults was fully explained when using propensity score matching methods to control for socioeconomic status (SES) at the individual and neighborhood levels. A previous study on the same topic using traditional regression-based methods reported that only 15% to 76% of the gap in self-reported health was explained, although this analysis used a different sample and covariates, so is not directly comparable [16].

The objective of this study was to explore whether contextual variable attenuate racial/ethnic disparities in the prevalence and severity of overweight and obesity among children and adolescents in the United States using the newly developed Symmetrized Rényi Index (SRI). There are several advantages to the SRI. It is invariant to the choice of the reference group for evaluating disparities and is more robust to changes in the outcome distribution than alternatives that are based on the commonly used generalized entropy class [40]. The SRI allows for the examination of disparities in the severity of a disease and the prevalence, across multiple groups. The SRI also allows for the groups to be weighted equally or according to population size, an important consideration in the measurement of health disparities as each method is associated with an implicit value judgment concerning the importance of the disease burden for an individual versus the disease burden of a group [41–46]. Although the SRI has been previously used to examine disparities in selected oral health outcomes and blood cholesterol levels, [40,47,48] the use of a covariate-adjusted SRI to examine health disparities has not yet been established.

There are three principal contributions of this article over existing literature. First, a variety of social determinants were examined in relation to weight disparities, including neighborhood-level sociodemographic and economic characteristics and segregation indicators. Second, propensity score subclassification was used to improve covariate balance across racial/ethnic groups and to produce a covariate-adjusted health disparity index, going beyond prior descriptive (unadjusted) analyses. Third, in the absence of an exact reference distribution, this article provides a sound empirical procedure for testing the statistical significance of the SRI in the context of complex survey data, as described in the Appendix.

Materials and methods

Data sources and study population

Data were from 18,639 children and adolescents aged 2 to 18 years who participated in the examination component of the National Health and Nutrition Examination Surveys (NHANES) from 2001 to 2010. NHANES is a cross-sectional survey of the civilian, noninstitutionalized US population conducted continuously in 2-year survey cycles [49]. NHANES uses a complex multistage probability sampling design, with some subgroups oversampled. Standardized weight and height measures collected in the 2001 to 2010 examination component of NHANES were used to calculate age- and sex-specific BMI percentiles for children and adolescents aged 2 to 18 years, according to the 2000 Centers for Disease Control and Prevention growth charts [50,51]. Children were classified as overweight or obese if they had a BMI percentile of 85 or more. Other variables in the NHANES public-use data files include age, sex, race/ethnicity, income-to-poverty ratio, caregiver education level (i.e., <high school, high school, >high school), and caregiver marital status (i.e., single/divorced/widowed, married/cohabitating). Of the eligible sample, 440 were excluded because of missing BMI, leaving a final analytic sample of 18,199 (97%). Unweighted response rates for the total examined sample range from 75% to 80% for the five survey cycles covering 2001 to 2010. Sample sizes of racial/ethnic subgroups other than non-Hispanic white, non-Hispanic black, and Mexican American are small; thus, results are not presented for other racial/ethnic groups. NHANES restricted data files provide geographic identifiers (i.e., Federal Information Processing Standards codes) which were used to link participating children and adolescents to census tracts and/or counties. Survey weights were combined across the five 2-year survey cycles from 2001 to 2010 to enable statistical inference by race/ethnicity and other SES characteristics after propensity score subclassification [52].

Data on county-level residential racial segregation were obtained from the RAND Center for Population Health and Health Disparities Data Core Series, available from the Inter-university Consortium for Political and Social Research [53]. Data on tract- and county-level sociodemographic characteristics (e.g., racial/ethnic population distribution, age distribution, and population size), socioeconomic factors (e.g., percentage of poverty, median income, percentage of population with less than high school education), crime (e.g., number of arrests per 100,000 county residents) were drawn from US Federal Bureau of Investigation Uniform Crime Reporting Program [54] and the decennial US Census [55] for the year 2000. The urbanerural designation of each county was obtained from the National Center for Health Statistics Urban Rural Classification scheme [56].

Measures

The two main variables of interest were the proportion of children and adolescents with age- and sex-specific BMIs of 85th percentile or greater (prevalence) and the BMI percentile for children and adolescents classified as overweight or obese (severity).

The following variables were combined to create a census tract-level socioeconomic deprivation index, as described in Table 1: proportion of adults aged older than 25 years with less than a high school education; proportion of males aged older than 16 years who are unemployed; proportion of families below the poverty threshold; proportion of households receiving public assistance; proportion of female-headed households with children; and median household income. Higher values of the socioeconomic deprivation index indicate worse SES profile; prior research used factor analyses to derive the variables included in the index, and the index has been used in several prior analyses of neighborhood SES and health outcomes, including weight status and dietary intake [53,57–62]. To account for the various conceptual dimensions to segregation, several indices of residential racial segregation were included at the county level [63,64]. These various indices were all included to account for various dimensions of segregation that have been described in the literature and because the reliance on any single measure of segregation has limitations [64]. We therefore include two-group measures that capture blackewhite segregation and multigroup measures that capture a fuller range of diversity. Prior research has also documented associations between residential racial segregation, typically operationalized using the isolation index, and weight outcomes and dietary intake among adults [15,65,66].

Table 1 provides a complete list of covariates included in the propensity score estimation.

Statistical methods

Propensity score subclassification was used to evaluate and improve covariate balance between the various racial/ethnic subgroups. Propensity score subclassification creates comparable subgroups by matching “exposed” and “unexposed” individuals on a set of observed characteristics [67,68]. In this case, instead of matching on an exposure, we matched on race/ethnicity, using non-Hispanic white children and adolescents as the reference group, and created five quintiles or subclasses based on the estimated propensity scores [36,39]; see Appendix A for details. It is important to note that we are not examining the “causal” effect of race/ethnicity, but rather exploring racial/ethnic differences both within and across the subclasses/quintiles to determine if these disparities are mediated by the included set of covariates. Conceptually, this strategy is similar to examining the interaction between race/ethnicity and the set of SES and sociodemographic variables that went into calculating the propensity score, as previous studies looking at weight disparities have reported interactions between race/ethnicity and SES [7,69–71].

Health disparities were evaluated using the SRI, which is described in the following. The SRI was calculated based on the two variables of interest for the total sample, and again across the five subclasses of propensity scores. Statistical significance of the SRI was evaluated using resampling techniques, as shown in Appendix B.

The Symmetrized Rényi Index

The between-group SRI is a class of health disparity indices defined for all $\alpha \neq 0, 1$ as follows:

$$\mathrm{SRI}_{\alpha} = -\frac{1}{2\alpha(1-\alpha)} ln \left\{ \left(\sum \bar{p}_j \bar{r}_j^{1-\alpha} \right) \left(\sum \bar{p}_j \bar{r}_j^{\alpha} \right) \right\}$$

for $\bar{p}_j = p_j / \sum p_l$ and $\bar{r}_j / \sum \bar{p}_l r_l$. Typically, the relative disparity r_j is the ratio of the average outcome in group j to the population average outcome; however, taking the best-off group as the reference or using any other reference yield the same SRI—the latter is said to be strong scale invariant. The group weights p_j are either all equal (equally weighted) or are proportional to group size (population weighted). The special cases SRI_1 and SRI_0 are given by,

$$\mathrm{SRI}_1 = \frac{1}{2} \sum \bar{p}_j \left(\bar{r}_j - 1 \right) ln \bar{r}_j = \mathrm{SRI}_0$$

For all α, it is known that $\mathrm{SRI}_{\alpha} \geq 0$, with equality if and only if all groups have the same average outcome. The standardized SRI, $1 - e^{-\alpha \mathrm{SRI} \alpha}$, is symmetric relative to $\alpha = 1/2$, and it is nondecreasing as a moves away from 1/2. Thus, $\alpha = 1/2$ is the most conservative disparity aversion parameter value for this class of disparity indices [40].

For continuous outcomes, the SRI can be decomposed to estimate the disparity between- and within-groups, and analytic expressions similar to the ones displayed previously are available for the total and/or aggregate SRI and its within-group component. In addition to subgroup decomposability, the SRI is advantageous for the following reasons: (i) both population-weighted and equally weighted versions can be calculated; (ii) it incorporates an “aversion parameter” (α), similar to the Atkinson index, which allows for the reflection of a range of societal values placed on inequity—higher values of α produce larger inequalities corresponding to a greater aversion to disparities; (iii) it does not depend on the choice of a reference group; (iv) it is more robust than its generalized entropy-based counterpart—more commonly used—to small changes in the distribution of the health outcome [40].

Results

Sociodemographic characteristics and the prevalence of over-weight and obesity among the sample of 18,199 children and adolescents can be seen in Table 2. The mean age was 10.2 years (95% CI, 10.0–10.3). Approximately 60% of the sample was non-Hispanic white, 14%

was non-Hispanic black, and 13% was Hispanic. The category "other" in NHANES is heterogeneous (unweighted *n* = 2186) and not reported separately here, although they were included in the analysis. The magnitude of differences between racial/ethnic subgroups was large for many individual-level and contextual covariates (see Table 2). Approximately 15.0% of the sample was overweight, and 16.7% obese (31.7% were either over-weight or obese). The mean BMI percentile among the overweight or obese children was 94.4. Non-Hispanic black (35.8%) and Mexican American children and adolescents (38.7%) were more likely to be overweight than non-Hispanic white children and adolescents (29.3%; $P < 0.001$). Additionally, among those who were overweight or obese, non-Hispanic black and Mexican American children and adolescents had higher BMI percentiles (94.8 and 94.6, respectively) than their non-Hispanic white counterparts (94.1; $P < 0.01$).

Overweight or obesity

The SRI was significantly different from that expected under the null hypothesis of equitability, confirming the presence of racial/ethnic disparities in the crude prevalence of overweight or obesity; see Figure 1. Figure 1 (top panel) illustrates the pattern across a range of aversion parameters (0.5–16). The pattern for the population weighted was similar to that for the equally weighted SRI; therefore, only the equally weighted SRI is shown here. In addition, because of the variable racial/ethnic population composition within each propensity score quintile group, the equally weighted SRI is more readily comparable across quintile groups.

Table 3 describes the proportion of the sample categorized as overweight or obese by race/ethnicity and the severity of excess weight among that group across propensity score quintiles. Racial/ethnic disparities were completely attenuated across all propensity score quintiles and observed SRIs did not differ significantly from those expected under the null hypothesis of equitability; see Figure 2.

Severity

The bottom panel of Figure 1 illustrates that the null hypothesis of between-group equitability in the severity of overweight and/or obesity is rejected at the 1% level of significance, confirming the presence of racial/ethnic disparities in the crude severity of excess weight. However, as shown in the middle panel of Figure 1, the between-group component remains between 0.5% and 0.6% of the total and/or aggregate index, suggesting that individual-level variation in severity of overweight and/or obesity is largely unaccounted for by race/ethnicity alone. No significant disparities in the severity of excess weight persisted after propensity score subclassification. This is corroborated in Figure 3 for the between-group component of the total and/or aggregate SRI for racial/ethnic disparities in severity of overweight and/or obesity. See also Table 3.

Discussion

Accounting for social context attenuates observed racial/ethnic disparities in obesity prevalence and severity among children and adolescents in the United States. Although prior studies have sought to explain disparities in childhood obesity, the majority have examined individual or family factors such as parent education or SES, physical activity patterns, dietary intake, and breastfeeding [72,73]. Some studies have suggested that after accounting for these limited social and behavioral factors, residual differences between racial or ethnic groups may have genetic underpinnings [74,75]. However, the many limitations of prior studies preclude that particular conclusion. Relying solely on individual-level measures may mask racial or ethnic differences in environments [69,76] and these differences may not be resolved using traditional regression methods. One recent study of adults in NHANES from 2003 to 2008 reported that the blackewhite gap in weight outcomes was not attenuated after controlling for features of the built environment such as street connectivity, census-tract SES, population density, or distance to parks, although these factors were associated with obesity [19]. Findings presented here stand in contrast to that study, as using propensity score methods to ensure that racial and ethnic subgroups were balanced in terms of exposure to a wide range of social determinants lead to a complete attenuation of weight disparities among children and adolescents.

Prior research has documented that the poorest white children live in higher opportunity neighborhoods than the majority of black or Latino children [77]. Residential segregation has been found to influence health behaviors and outcomes such as fruit and vegetable intake, [78] physical activity, [79] smoking during pregnancy, [80] and BMI among adults [15,60] through differential access to geographies of opportunity, including factors related to education, employment, and health-promoting resources such as physical activity facilities, sources of healthy food, and health-care facilities [63,81]. In this sample of children and adolescents in NHANES from 2001 to 2010, there were substantial imbalances across contextual and individual-level characteristics such as income, parent education, neighborhood SES, and residential segregation. Resolving these imbalances through propensity score subclassification resulted in a complete attenuation of racial/ethnic disparities in the prevalence and severity of excess weight. Propensity score methods are one strategy to evaluate and improve covariate imbalances. Findings presented here are consistent with the few other studies that have used propensity score matching methods and reported that racial/ethnic disparities among adults are substantially, if not wholly attenuated [36,39].Our results highlight the importance of examining more upstream or distal factors such as neighborhood disadvantage or residential segregation in the context of weight disparities, rather than solely focusing on more proximal individual or family factors such as health behaviors. An additional strength of this analysis is the focus on children as prior studies using adult samples may have been subject to substantial misclassification of exposure when using concurrent SES and sociodemographic covariates, when early or cumulative exposures across the life-course may be critical [39,82]. Although studies of children may still suffer from this limitation, it may be less problematic than for adults as cumulative disadvantage contributes to widening health inequalities over time [83].

This study has some limitations. Results may be subject to endogeneity and self-selection biases because of the use of cross-sectional observational data. Using subclassification may not remove as much bias as 1:1 matching or propensity score weighting methods, but we did not want to remove observations by matching or compromise the national representativeness of the sample by reweighting. One limitation of propensity score subclassification is the potential for residual intrasubclass confounding or bias, and residual confounding from unobserved characteristics, such as food availability, physical activity resources, discrimination, or school quality We did not have measures of the availability of healthy food or access to safe places to play, or other potential mediators between neighborhood socioeconomic and demographic characteristics and weight outcomes or disparities. Prior research has shown inequities in neighborhood food and built environments and these factors are associated with dietary intake, physical activity, and weight [18,62,84–88]; but this analysis cannot speak to these potential causal pathways. Moreover, neighborhood was defined in this study using census boundaries, which may not meaningfully reflect neighborhood units; however, because of the reliance on national data, using locally derived neighborhood boundaries was not an option. Different results may be obtained using alternative matching methods or when choosing non-Hispanic black or Mexican American children and adolescents as the reference group [36]. In addition, the multilevel logit model was not enhanced any further than including all covariates listed in Table 1 and including a county-level random intercept. Although refining the fitted propensity scores can improve the covariate balance obtained in the final subclassification, the added complexity of the modeling effort was not practically justified here [89]. The measures of residential racial segregation that are included in the logit model, together with all other county- and tract-level characteristics, are static measures (based on the year 2000 decennial Census) that do not take into account any changes in county or tract composition over time. However, prior studies following a lifecourse perspective suggest that previous or cumulative exposures to neighborhood characteristics may be more closely tied to health outcomes than concurrent exposure [39,83,90]. Finally, the analytic strategy used does not allow for the examination of differential effects of various social determinants by race/ethnicity, as has been reported in prior studies [59,60,91,92] The use of a multigroup summary disparity measure such as the SRI precludes the comparison of these potential differential associations by racial and ethnic subpopulation.

This study is one of the first to use propensity score subclassification to evaluate and improve covariate balance across a range of social determinants that may be related to weight disparities. Results of this analysis suggest that accounting for social determinants through propensity scoremethods explains noted disparities in the prevalence and severity of excess weight among children and adolescents in the United States.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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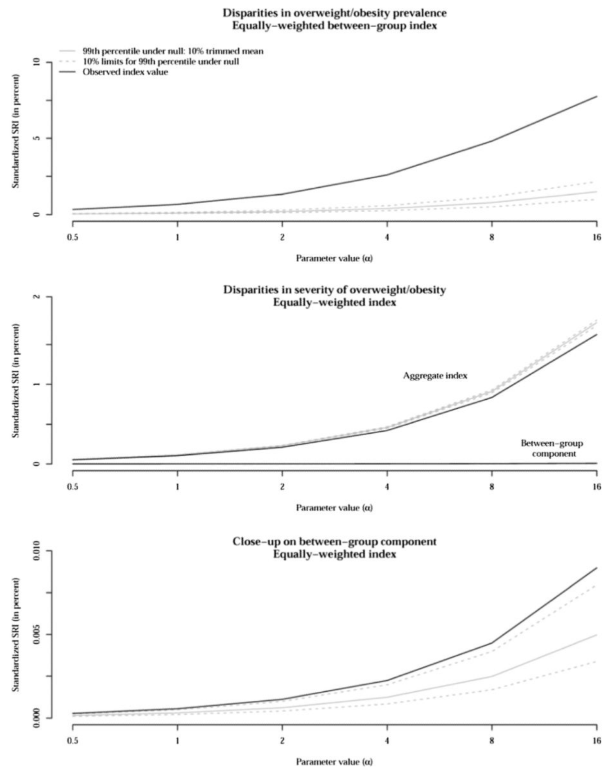

Fig. 1.

The SRI for overall racial/ethnic disparities in the prevalence and severity of overweight and/or obesity. Only values of the disparity aversion parameter α equal to or greater than 0.5 are shown because of symmetry of the SRI. The value $\alpha = 0.5$ gives a lower bound for the standardized SRI and is the most conservative disparity aversion parameter value. For all parameter values, the null hypothesis of between-group equitability in the prevalence (top panel) and severity (bottom panel) of overweight and/or obesity is rejected at the 1% level of significance, as indicated by the black lines exceeding the light grey dotted lines. However, the between-group component remains between 0.5% and 0.6% of the total and/or aggregate index (middle panel), suggesting that individual differences in severity of overweight and/or obesity are largely unaccounted for by race/ethnicity alone.

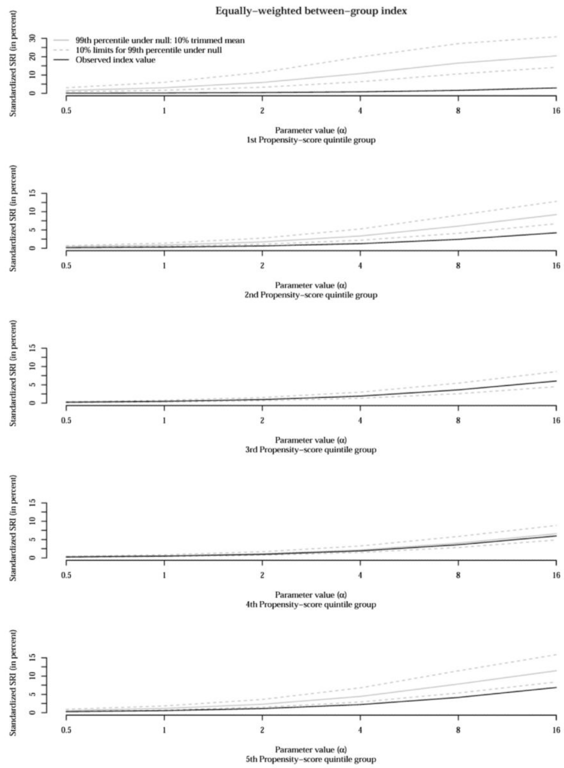

Fig. 2.

The SRI for racial/ethnic disparities in the prevalence of overweight and/or obesity, stratified by propensity score quintile. All disparities are attenuated and/or eliminated and no longer significant. For all values of the disparity aversion parameter a, the null hypothesis of between-group equitability in the prevalence of overweight and/or obesity cannot be rejected at the 1% level, as none of the black lines exceed the light grey dotted lines.

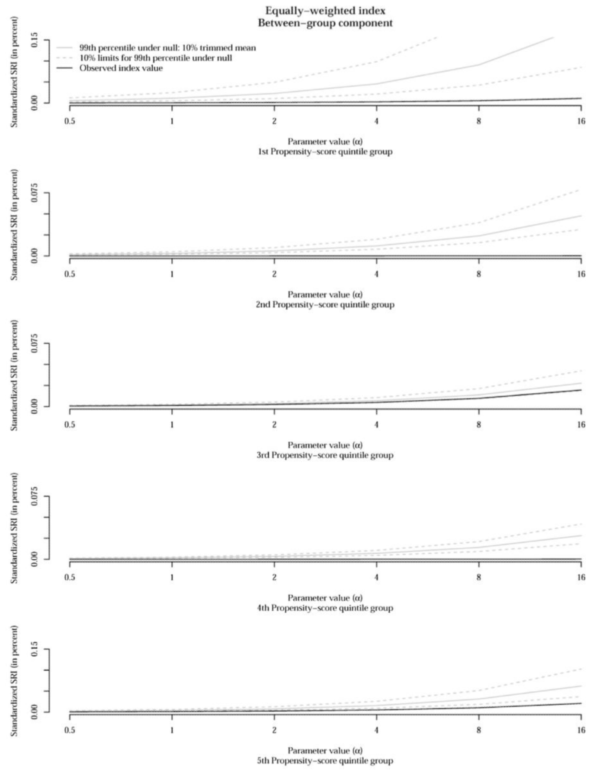

Fig. 3.

The SRI for racial/ethnic disparities in the severity of overweight and/or obesity, stratified by propensity score quintile. For all values of the disparity aversion parameter a, the null hypothesis of between-group equitability in the severity of excess weight among those classified as overweight or obese cannot be rejected at the 1% level, as none of the black lines exceed the light grey dotted lines.

Table 1

Variables included in propensity score estimation.*

Individual or household-level variables from NHANES 2000–2010:

Caregiver marital status†: married or cohabitating; single/divorced/widowed

Age

Sex

Household Income-to-Poverty Ratio†

Caregiver education†: less than high school; high school degree; some college or higher

County-level variables:

Segregation indices ‡

Dissimilarity Index:

$$\sum_{m=1}^{M}\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)\mid p_{k,m}-p_m\mid$$

Information Index:

$$\sum_{m=1}^{M}\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)p_{k,m}\ln\left(\frac{p_{k,m}}{p_m}\right)$$

Normalized Exposure Index:

$$\sum_{m=1}^{M}\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)\frac{\left(p_{k,m}-p_m\right)^2}{\left(1-p_m\right)}$$

Exposure Index (black vs. white):

$$\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)\left(\frac{p_{\text{black}}p_{\text{white}}}{p_{k,\text{black}}}\right)$$

Gini Index:

$$\sum_{m=1}^{M}\sum_{k=1}^{K}\sum_{l=1}^{K}\left(\frac{t_k}{T}\right)\left(\frac{t_l}{T}\right)\mid p_{k,m}-p_{lm}\mid$$

Relative Diversity Index:

$$\sum_{m=1}^{M}\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)\left(p_{k,m}-p_m\right)^2$$

Squared Coefficient of Variation Index:

$$\sum_{m=1}^{M}\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)\frac{\left(p_{k,m}-p_m\right)^2}{p_m}$$

Isolation Index (black vs. white):

$$\sum_{k=1}^{K}\left(\frac{t_k}{T}\right)\left(\frac{p_{\text{black}}p_{\text{black}}}{p_{k,\text{black}}}\right)$$

Urban/rural category§: large central metropolitan; large fringe (population ≥ 1 million); medium fringe (population 250,000–999,999); small fringe (population >250,000); micropolitan; rural.

Arrests per 1000 population//

Proportion of county that is urban
Square miles
Census tract-level [¶] ***variables***
Proportion of vacant housing units
Proportion of owner-occupied housing units
Median housing unit value
Deprivation Index [#]

[*] State and survey year were also included in propensity score models.

[†] Caregivers who did not report education level, marital status, or income were still included in models as these covariates included dummy-codes for missingness.

[‡] Segregation indices constructed using county-level population data from the RAND Center for Population Health and Health Disparities Data Core Series. All county-level segregation indices are normalized to take values between 0% and 100%, where 0 indicates no segregation [64]. For all 8 county-level segregation indices: T is the total population; p_m is the proportion of the population in group m (e.g., non-Hispanic black); M is the number of racial/ethnic groups (here, $M = 5$); t_k is the number of individuals in county k; K is the total number of counties; $p_{k,m}$ is the proportion of individuals in group m for county k.

[§] From the National Center for Health Statistics Urban-Rural Classification Scheme.

[//] Data are drawn from the U.S. Federal Bureau of Investigation Uniform Crime Reporting Program for the year 2000.

[¶] All tract-level population data are drawn from the year 2000 decennial U.S. Census.

[#] Tract-level deprivation index is constructed by first standardizing then averaging the following variables: proportion of adults over 25 years with less than a high school education; proportion of males over 16 years who are unemployed; proportion of families below the poverty threshold; proportion of households receiving public assistance; proportion of female-headed households with children; and median household income. These variables were transformed for normality and direction, and their Z-scores were averaged; higher values indicate worse SES profile.

Table 2

Sociodemographic characteristics of US children and adolescents, aged 2 to 18 years, with valid BMI measure, NHANES 2001 to 2010 (n = 18,199; values indicate survey weighted means/proportions [95% CIs†])

Characteristic	Non-Hispanic white (unweighted *n* = 5413)	Non-Hispanic black (unweighted *n* = 5250)	Mexican American‡ (unweighted *n* = 5350)
Individual/family characteristics			
Mean age (y)	10.4 (10.2–10.6)	10.2 (10.0–10.4)	9.5 (9.3–9.8)
% Female	48.6 (47.1–50.0)	49.6 (48.2–51.0)	49.0 (47.4–50.6)
% with BMI ≥ 85th percentile	29.3 (27.3–31.3)	35.8 (34.4–37.2)***	38.7 (36.8–40.6)***
Mean BMI percentile for overweight/obese	94.1 (93.8–94.4) (unweighted *n* = 1573)	94.8 (94.6–95.1)*** (unweighted *n* = 1850)	94.6 (94.5–94.8)** (unweighted *n* = 2061)
Mean income-to-poverty ratio	2.9 (2.8–3.1)	1.8 (1.7–1.9)***	1.6 (1.5–1.7)***
% With caregiver education < high school	11.3 (9.3–13.3)	30.2 (27.4–33.0)***	53.6 (50.1–57.2)***
% With caregiver married/cohabitating	81.1 (79.3–82.8)	43.9 (41.4–46.3)***	78.2 (76.2–80.2)*
County (*n* = 159) and tract (*n* = 2836) characteristics			
Tract deprivation index§	−0.6 (−0.6 to −0.5)	0.4 (0.3–0.4)***	0.1 (0.0–0.2)***
County dissimilarity index (%)§	60.4 (58.5–62.3)	62.5 (61.2–63.7)*	60.3 (57.2–63.4)
County information index (%)§	39.1 (37.0–41.1)	41.6 (40.2–43.1)*	40.1 (37.1–43.2)
County isolation index (%)§	86.3 (85.6–87.1)	83.9 (82.9–84.8)***	79.5 (75.3–83.7)**
County arrests per 1000	36.1 (32.9–39.4)	52.5 (47.6–57.3)***	44.1 (40.2–48.0)**
County % urban	67.9 (62.4–73.4)	90.8 (87.8–93.8)***	91.2 (88.6–94.0)***

Significant differences relative to the non-Hispanic white group indicated by

Although all covariates listed in Table 1 were included in the propensity score models, only a limited set are displayed here for descriptive purposes.

*** $P < .001$,

** $P < .01$,

* $P < .05$.

† Confidence intervals are design based, obtained via Taylor series linearization.

‡ The category “other” in NHANES consists of Hispanic or Latino other than Mexican American and non-Hispanic of races other than black and white, including multiracial. Because of its heterogeneity and lack of representativeness, this “other” category, with unweighted n = 2186, is not reported here.

§ The tract deprivation index has a mean of 0 and a standard deviation of 1, with higher values reflecting more deprivation. The segregation indices (dissimilarity, information, and isolation) all range from 0% to 100% with higher values reflecting greater segregation.

Table 3

Weight outcomes (95% CIs*) by propensity score quintile group and race/ethnicity

Propensity score quintile	Non-Hispanic white	Non-Hispanic black	Mexican American†
Prevalence (%)			
Quintile 1	39.7 (24.5–54.9)	37.0 (34.1–39.9)	41.2 (38.9–43.4)
Quintile 2	33.3 (26.3–40.4)	32.7 (29.5–35.8)	40.1 (36.6–43.6)
Quintile 3	26.0 (21.9–30.0)	37.0 (34.4–39.6)	34.9 (30.5–39.3)
Quintile 4	28.5 (25.7–31.3)	37.1 (33.8–40.5)	37.2 (33.1–41.3)
Quintile 5	29.9 (26.9–32.9)	37.6 (31.1–44.1)	34.2 (26.1–42.4)
Severity (BMI percentile among overweight or obese)			
Quintile 1	94.7 (93.1–96.3)	94.7 (94.1–95.2)	94.8 (94.5–95.1)
Quintile 2	94.8 (93.7–96.0)	94.8 (94.4–95.3)	94.7 (94.3–95.2)
Quintile 3	94.3 (93.7–95.0)	94.9 (94.3–95.4)	94.2 (93.7–94.7)
Quintile 4	94.2 (93.7–94.7)	95.1 (94.7–95.6)	94.7 (94.2–95.2)
Quintile 5	93.9 (93.5–94.3)	94.7 (93.7–95.7)	94.3 (93.4–95.2)

Propensity scores were estimated by matching on race/ethnicity, using non-Hispanic white children and adolescents as the reference group, and the predicted scores were used to create five quintiles or subclasses.

*Confidence intervals are design based, obtained via Taylor series linearization.

†The category “other” in NHANES consists of Hispanic or Latino other than Mexican American and non-Hispanic of races other than black and white, including multiracial. Because of its heterogeneity and lack of representativeness, this “other” category (unweighted n = 2186) is not reported here.